

# **An Overview of My Internship with the Ecological Program at John F. Kennedy Space Center**

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## **I. Abstract**

During my internship with Innovative Health Applications, I participated in numerous long-term research projects involving the study of various plant and animal life at the Kennedy Space Center (KSC). I observed the monitoring of nesting sea turtles. I learned about the transfer of egg clutches from the northern Gulf Coast in an effort to help the hatchlings avoid the oil spill in the Gulf of Mexico. I gained knowledge of tracking the movements of important sport fish and sharks in this area using a hydro-acoustic tag and receiver system. This effort included routinely taking water quality data at multiple sites around KSC. Alligator population and nesting assessments was another part of my internship. I observed the biologists take morphometric measurements, blood, urine and tissue samples from alligators found in KSC waterways. I assisted in taking photosynthesis and reflectance measurements on various scrub oaks and palmettos. I participated in Florida Scrub-Jay surveys in an effort to monitor their population trends and was involved in Southeastern beach mouse trapping and identification. I also assisted in seagrass surveys monitoring the health of the seagrass beds.

## **II. Introduction**

The majority of my internship at John F. Kennedy Space Center, (KSC), took place performing field work and ranged all over the Merritt Island National Wildlife Refuge (MINWR).

### **A. John F. Kennedy Space Center**

On July 29, 1958, Dwight D. Eisenhower signed Public Law 85-568 forming the National Aeronautics and Space Administration (NASA). In 1962 NASA expanded from the Cape Canaveral Air Force Station, its current launching facility, and established the Launch Operations Center. Only a year later on November 29, 1963, the center was renamed the John F. Kennedy Space Center by President Johnson seven days after the Kennedy assassination in honor of President Kennedy and his vision to put a man on the moon (<http://www.nasa.gov/centers/kennedy/about/history/timeline/1950>).

### **B. Merritt Island National Wildlife Refuge**

NASA acquired 140,000 acres of land for the establishment of its Launch Operations Center in 1962. The overwhelming majority of this land served as a buffer zone between the center and the public and remained undeveloped. On August 28, 1963, the U. S. Fish and Wildlife Service signed an agreement establishing the Merritt Island National Wildlife Refuge. In 1975 the Canaveral National Seashore was established.

Today the Merritt Island NWR is composed of seven different types of habitat: beaches, coastal dunes, saltwater estuaries and marshes, brackish impoundments, scrub, pine flatwoods, and hardwood hammocks. The refuge is home to 15 threatened and endangered species and provides a habitat for over 500 species of wildlife and over 1,000 species of plants in total. The refuge is maintained using controlled burns, which are talked about later in this paper, and varying forms of water management (<http://www.fws.gov/merrittisland/>).

### **C. Water Management**

Up until the 1950's the Merritt Island area was primarily composed of salt marshes. Wind driven "tides" routinely flooded the area with water from the Indian River Lagoon creating large mud flats which are the perfect breeding habitat for the salt marsh mosquito. As the area started to develop as a result of the new Kennedy Space Center, the mosquitoes became a major problem for local residents. A network of earthen dikes was created to

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impound the water and maintain semi-permanent flooded conditions during the fall and summer months, mosquito breeding season. This meant that the water never receded to expose the mud flats and effectively eliminated the mosquito's breeding habitat. However, this had very negative effects on the salt marshes as a whole. Now, the water level is lowered during the spring and summer to allow vegetation to grow and is raised during the fall to prevent mosquitoes from breeding and hatching. This creates a good habitat for small fishes, crabs, invertebrates and worms which serve as food for migratory waterfowl, wading birds and shorebirds. In some areas the impoundments have had culverts built into them to allow for natural water flow across the dike. The overall plan is to return the area to its natural environment so far as it doesn't pose any major negative threats to the local developments (<http://www.fws.gov/merrittisland/Watermanagement.html>).

### III. Sea Turtles

A major part of my internship with IHA was centered around the sea turtle nesting season. A reproductively mature female will return to the same beach (within a few kilometers) on which she hatched to lay her eggs. Sea turtles generally nest at night which provides cover from predators and is a much cooler than the heat of the day. A female will nest about every two weeks for the duration of the nesting season averaging three to five nests per season; however she will not nest every year but every two to three years (Per. Com., S. Gann, June 2010).

#### A. Species

There are three species of sea turtles that nest on KSC beaches: loggerhead (*Caretta caretta*), green turtle (*Chelonia mydas*), and leatherback (*Dermochelys coriacea*). Of the three, loggerheads are the most common followed by greens. On average, only a handful of leatherbacks nest on KSC beaches each year (Per. Com., S. Gann, June 2010).

##### 1. Loggerhead Sea Turtle

Loggerheads were named for their large heads and were originally called largerheads. They are a threatened species in southeast Florida and are endangered in other parts of the world. Using their extremely powerful jaws, they mostly feed on hard-shelled prey such as conch, crustaceans and various bivalves. The mean straight carapace length of an adult is approximately .92 meters (3ft), and they weigh an average of 113kg (250lbs). Loggerheads reach sexual maturity between 25 and 35 years of age (<http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm>). Their nesting season at KSC starts in May and last through August peaking in late June and early July. A loggerhead will lay about 120 eggs in each nest.



Figure 1: Loggerhead sea turtle



Figure 2: Loggerhead nest

A loggerhead's crawl can be identified by its asymmetrical tracks. Like humans, when we step with our left foot our right arm will swing forward, they crawl by alternating their flippers. When performing a morning sea turtle nesting survey, properly permitted and trained biologist, use clues in the sand left behind by the previous night's nesting sea turtle. What we see in a loggerhead crawl is their back flipper tracks which look like commas. The direction of the crawl can be identified by looking at which way the sand is being pushed. This helps us identify the inbound and outbound tracks (FFWCC 2007). All sea turtle emergences from the water are called "crawls". Crawls that result in the deposit of eggs in the sand are called "nests" and non nesting crawls are called "false crawls" (Schroeder 1999). When attempting to nest, the turtle will first create a body pit and then dig her egg chamber using her back flippers. Once she is done laying her eggs, she will push sand towards the egg chamber using her front flippers creating front flipper scarp in the sand, and then cover the eggs with the sand using her back flippers. We can tell if the female nested by looking for a mound of sand that covers and is wider than her inbound track. This can be difficult because turtles will sometimes abandon a body pit or egg chamber without nesting at all, resulting in a false crawl. This is when we check for front flipper scarping which when present almost guarantees she nested. Sometimes turtles will nest on a dune in vegetation. In these cases it is easiest to identify a potential nest by checking if there is any uprooted vegetation, not just broken (FFWCC 2007).



## 2. Green Sea Turtle

Greens look very similar to loggerheads except their head is much smaller and they have slightly longer front flippers. They are an endangered species and are the largest hard-shelled sea turtle in the world. Green turtles are unique in that, as adults, they are herbivorous and mainly eat seagrasses and algae. This gives their fat a greenish color which is where they get their name from. Their mean straight carapace length is approximately one meter (3.3ft) with an average weight of 135-160kg (300-350lbs). Greens reach sexual maturity anywhere between 20 and 50 years of age and nest on KSC between June and August peaking in late July. Females will lay an average of 135 eggs per nest (<http://www.nmfs.noaa.gov/pr/species/turtles/green.htm>).

Unlike loggerheads, green sea turtles have a symmetrical crawl. They have immensely powerful front flippers which is what they mainly use when they crawl. They do not alternate their flippers but use both front flippers at the same time which is what makes their crawl symmetrical (FFWCC 2007). When a green turtle nests it looks like a bomb went off in the sand. They dig a deep body pit and when covering their eggs throw lots of sand a great distance with their powerful front flippers. The amount of disturbed sand is much greater than a loggerhead's which makes the clutch a lot harder to find. A green turtle's egg chamber can be about one meter deep in the sand. One theory for locating a green turtle clutch of eggs, is to draw a circle around the body pit and extend that circle into a figure eight, the clutch should be at the tip of the second circle (Wood 2004). However, in my limited experience this is rarely the case. Of the green turtle nests that were dug, the clutch was rarely in the same place.

## 3. Leatherback Sea Turtle

Leatherbacks are the largest living marine reptile in the world. They are the only cartilaginous shelled sea turtle. A leatherback's shell is made up of a leathery, oil-saturated connective tissue that overlay loosely interlocking dermal bones. They have seven longitudinal ridges that run the length of the shell and appear black in color. Adults average two meters in length (6.5ft) and can weigh up to 900kg (2,000lbs) (<http://www.nmfs.noaa.gov/pr/species/turtles/green.htm>). Their sharp edged jaws allow them to eat mostly jellyfish; also their throat and mouth are lined with sharp papillae which help them contain their gelatinous prey (Wyneken 2001). A female will lay approximately 100 eggs in each clutch; however, unlike loggerheads and green turtles, leatherbacks also lay very small separator or spacer eggs that are unfertilized but serve the purpose of separating the large fertilized eggs. Some scientists think leatherbacks lay spacer eggs as a kind of support for the fertilized eggs so they don't squish each other. On the KSC beach leatherbacks nest as early as mid-March through early July.

Like greens, leatherbacks have a symmetrical crawl and only use their extremely powerful front flippers (FFWCC 2007). Leatherbacks also disturb a lot of sand while nesting creating the largest area. There isn't so much a large mound of sand as there is a large disturbed area of sand. This makes finding a leatherback's clutch nearly impossible without a lot of time, a lot of people, and a little luck unless you watch her lay her eggs. When they are finished nesting, leatherbacks will make a nautilus shaped orientation circle before heading back into the water (Wood 2004).

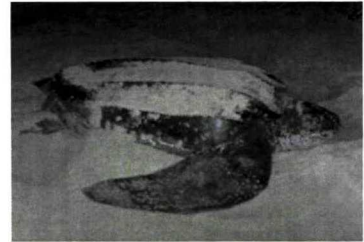


Figure 3: Leatherback sea turtle (Photo courtesy of S. Gann.)

## B. Hatchlings

On KSC beaches, eggs normally incubate for about 50-60 days, depending upon the species, before hatching (Per. Com., S. Gann, June 2010). Hatchlings will congregate just below the surface of the sand and emerge in waves creating safety in large numbers. Upon emergence they have approximately 72 hours of energy stores to crawl into the Atlantic Ocean, make it through the surf and swim to an area known as the Sargasso Sea. The currents that form to carry floating Sargassum seaweed make up the North Atlantic Gyre. These areas are usually characterized by converging surface waters which form downwelling. Floating algae and seaweed will collect in this area providing shelter and protection for the hatchlings. Scientist estimate one in every thousand hatchlings will make it to the turtle nursery due to predation from ghost crabs, hogs, bobcats, raccoons, sea birds and various fishes. It is estimated that only one in every 10,000 hatchlings will become sexually mature adults (<http://www.nmfs.noaa.gov/pr/species/turtles/>).

## C. Lighting and Disorientation

Sea turtles see best in the blue/green spectrum of visible light. They generally nest and hatch at night and use the light reflected off the ocean by the moon as a guide when crawling out of or back to the water. On a natural,



dark beach, the reflected light would be the brightest light at night. However on populated coastlines, often the brightest lights are the ones on buildings/structures and in parking lots that are in close proximity to the beach or contribute to the overall "glow" that you see around cities at night. This can cause turtles to disorient and crawl towards the lights instead of back into the water. Disorientation wastes the sea turtle's energy and can often result in the turtle's demise. This is particularly bad for hatchlings since they only have a certain amount of energy to make it all the way to the cover of the Sargasso Sea. KSC beaches are therefore extremely important since they are some of the darkest and most natural beaches left in Florida (Witherington and Martin 2000). The United States Fish and Wildlife Service (USFWS) issued a biological opinion (BO) to KSC regarding operational necessary artificial lighting. For this reason lighting surveys are conducted routinely in order to identify the problem lights that may cause a turtle to disorient (USFWS 2009). In order to reduce sea turtle disorientation, lights should be recessed and shielded and only point towards the areas that need to be illuminated. Lights used near nesting beaches should emit only the long wave length of this light spectrum. This can be achieved by replacing white lights with low pressure sodium, red, orange or amber LED lights that emit the part of the light spectrum that is less disruptive to sea turtles (Witherington and Martin 2000). At KSC, in accordance with the BO, when nighttime beach front lighting is necessary for launch operations, temporary light shields are placed around nests that are determined to be in trouble of disorienting in an effort to reduce the number of hatchling disorientations (USFWS 2009).

#### D. Methods

Under the guidelines of KSC's USFWS BO for light management, morning sea turtle emergence surveys are conducted using either an ATV or UTV to drive along the beach. Of the 10km of beach, nests are currently marked within the 3kms located in close proximity to shuttle launch complex 39. This section of beach is the area right in front of the launch pads and is considered the most vulnerable to disorientation due to erosion of the dunes in this area (USFWS 2009). When a nest is located, biologists dig strategic holes to locate the egg clutch. Knowing the location of the clutch helps in shielding the nest later. Once the clutch is located, the nest is marked with a flag (color-coded by week) elbow length (fingertip to elbow) inland from the clutch so as not to puncture any of the eggs. Using a GeoXT, GPS coordinates are recorded along with information such as species, flag color, date laid, position on the beach, dune height and vegetation height. All of this data is backed up on paper as well. In the event that a nesting female is found, she is checked for internal PIT tags and external flipper tags (Schroeder 1999). Approximately five days before the nest is due to emerge, nests that do not have sufficient coverage from dunes and vegetation are outfitted with a temporary light shield. Three days after the hatchlings emerge, the nest can be inventoried to determine emergence success. When inventorying a nest, all of the eggs are dug up and are classified to determine the level of development of each egg. The eggs are then reburied and the flag and shield are pulled. If live hatchlings are found, they can be released before 9:00AM. The hatchlings cannot be reburied since their air chamber is punctured upon being dug up and they would suffocate. Other data such as number of disorientations, large storms, and nest deprivation by hogs, ghost crabs, bobcats, etc. is also recorded (FFWCC 2007).



Figure 4: Hatchling emergence from a shielded nest in front of launch pad B

#### E. Gulf Coast Sea Turtles

The British Petroleum oil spill in the spring of 2010 caused major distress for Gulf Coast sea turtles. In an effort to help hatchlings avoid the oil spill all of the nests in Alabama and the Florida panhandle are being transported to KSC and released along the Cape Canaveral beaches. The nests are being allowed to incubate on their home beaches then carefully dug up approximately a week before they are due to hatch and transported via specialized FedEx trucks to KSC. The clutch arrives at KSC in styrofoam boxes with temperature probes sticking out of the side allowing the temperature of the clutch to be checked routinely. When the hatchlings start to emerge, a black cloth is placed over the box to block the light and postpone their "frenzy" until they can be released at night. It is not known whether the surviving turtles will return to east coast Florida beaches to nest or if they will find their way to their "home beaches" even though they did not hatch there. Regardless, their fate in the Gulf was deemed to be very high risk, and so this massive translocation was designed and approved by many sea turtle experts and conservationists. This is the largest undertaking in translocation of sea turtle clutches in history and no one is sure what the results will be (Per. Com., J. Provancha, July 2010).



#### IV. Sharks and Fishes

In and around KSC waterways there are many popular sportfish and shark species such as red drum, black drum, tarpon, spotted seatrout, snook, bull sharks and lemon sharks. Lemon sharks, named for their yellowish brown coloring, are a species of special concern as they are highly migratory along southeast Florida and all the way up to the Carolinas. In the winter time, hundreds of lemon sharks can be found right off Cape Canaveral. They spend most of the day near shore and go offshore at night to feed. There has been much collaboration with the Bimini Biological Field Station concerning lemon sharks. In an effort to track the movement patterns and rate of movement of these and other species, a subset of each population has been tagged with Vemco acoustic transmitters, and Vemco receivers have been strategically placed in the majority of KSC waterways (Per. Com., E. Reyier, June 2010).

##### A. Vemco Acoustic Tags and Receivers

The surgically implanted transmitters periodically emit a series of ultrasonic pulses that form an identification code unique to each animal. When a tagged animal swims within the detection range of a Vemco acoustic receiver, the receiver will pick up the signal and record the date, time and identification code of that animal. Receivers are usually placed in high value habitats or along migratory corridors. When thoughtfully designed, an acoustic array can effectively record behavior and survival of fishes as they move within or between ecosystems (Per. Com., E. Reyier, June 2010).

##### B. Methods

Sharks and fishes are caught using rod and reel or by cast net. The shark or fish is then placed ventral side up on a measuring board in a cooler with water just covering its gills. The area is disinfected with iodine and a scalpel is then used to carefully make an incision into the fish's body cavity just long enough to insert the Vemco tag (which can vary in size based on the size of the fish and battery life). Once the tag is inserted, the incision is stitched back up and covered with Neosporin. Sharks are then tagged with an external tag in their first dorsal fin and a fin clip is taken for genetic purposes. The length and weight of the fish are then taken before releasing it. It is better if the fish is released in colder water which helps "revive" the fish from its state of shock.

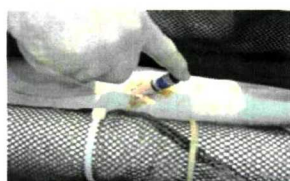


Figure 5: Inserting an acoustic transmitter into a fish (Photo courtesy of E. Reyier)

##### C. Water Quality

Water quality has many variables, such as salinity, dissolved oxygen, pH, temperature, biotoxins and suspended sediment which vary in different marine and fresh water environments. Monitoring the water quality of specific areas over a period of time can help explain an organism's behavior and environmental changes. For example, changes in salinity, temperature or dissolved oxygen due to rainfall, natural water evaporation or seasonal weather patterns could influence the movement patterns of various fish. Also, an increased amount of biotoxins in the water due to an algal bloom could be responsible for an increased amount of fish die-offs (Garrison 2005). For these reasons, and many others, water quality is routinely measured at determined sites in fresh, brackish and marine waters around KSC using a YSI water quality meter and secci disk. Sediment samples and other data such as air temperature, wind direction and cloud coverage are also taken at each site (Per. Com., D. Scheidt, June 2010).

#### V. Seagrasses

There are four main species of seagrass on KSC: manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), widgeon grass (*Ruppia maritima*), and star grass (*Halophila engelmanni*). The project I participated in was monitoring the seagrass beds along the north and south side of the NASA Causeway in the Indian River. Due to erosion of the causeway itself, large rocks were recently laid along either side to help prevent any more erosion. The fear was that this would negatively affect the surrounding seagrass beds which serve as a habitat for many species of fish and other marine animals (Per. Com., E. Reyier, July 2010).



Figure 6: Manatee grass (<http://www.csc.noaa.gov/benthic/resources/gallery/algae/filiforme.htm>)

### A. Habitat and Importance

Seagrass beds are considered to be high value habitats because of their importance to such a wide variety of species. The seagrasses themselves provide a food source for many herbivorous animals such as the West Indian manatee and the green sea turtle. Many seagrass beds also serve as a nursery for a wide range of marine animals such as juvenile sharks, fishes and sea turtles hiding them from larger predators lurking offshore. Seagrasses also help to prevent erosion as their roots hold the sediment in place and prevent it from washing away with the current or tides (Garrison 2005).

### B. Methods

The first step is to locate the previously determined transect lines (30 total) set 100 meters apart. The transects start at where the edge of the causeway was before the rocks were laid and run perpendicular to the causeway 50 meters into the water. The start of each transect is marked by a spray-painted stake while the endpoint is marked by a GPS point. A measuring tape is laid between the two points to form the transect. A 10x10 quadrat (100 squares total) is then used to survey the seagrasses every 10 meters along the transect. The quadrat is set by aligning the center of the quadrat with the 10 meter marker. Then a percent coverage is estimated and the number of shoots is counted in 8 of the 100 squares. Other data such as seagrass species present and epiphyte coverage on *Halodule wrightii*, are also recorded. By doing this routinely over a five year period, the health of the seagrass beds can be monitored and the effect on the seagrass beds of laying the rock can be determined (Per. Com., E. Reyier, July 2010).



Figure 5: Quadrat

## VII. American Alligator

The American alligator (*Alligator mississippiensis*) is one of the few species that has been downgraded from endangered to threatened due in a large part to conservation efforts. It is now estimated that there are over 1,000,000 alligators in the southeastern United States; the primary reason for the American alligator still being listed as threatened is because of its resemblance to the American crocodile which is endangered. Today alligators can be found in fresh water ditches and impoundments ranging all over KSC. Adult males on average reach lengths of 4 to 4.5 meters (13.1 to 14.8ft) and weight 180 to 228kg (400 to 500lbs). Adult females are slightly smaller and reach lengths closer to 3 meters (9.8ft). Alligators are very opportunistic feeders and will eat anything from fishes and turtles to large mammals and even other alligators. Alligators are known to have the most powerful bite in the animal kingdom.



Figure 10: American alligator

Adult females will make a nest a few days before laying her eggs. Nests are usually located close to a freshwater source and are made of grasses, leaves and small sticks. Upon laying her eggs, a female never ventures too far away from her nest and will become very defensive towards any threats to her eggs. A clutch usually consists of 20 to 50 eggs and will incubate for 60 to 65 days before hatching. Like sea turtles, the sex of the hatchlings is completely dependent on the temperature at which they incubate. If the average temperature of the alligator nest is below 30°C (86°F) the majority of the hatchlings will be female. If the average temperature is above 34°C (93°F) the majority of the hatchlings will be male. A nest temperature between 30°C and 34°C will result in an even mix of males and females. This relationship between hatchling sex and temperature has been well studied in the lab, but there is very little in situ data on this relationship ([http://www.flmnh.ufl.edu/cnhc/csp\\_amis.htm](http://www.flmnh.ufl.edu/cnhc/csp_amis.htm)).

### A. Keystone Species

Alligators are a keystone species. A keystone species is a species whose addition or loss from an ecosystem leads to major changes in abundance or occurrence of at least one other species. Since alligators are apex predators, any biotoxins that enter the food web at any level will show up in alligators. If closely monitored, this can give warning to humans about possible biotoxins or diseases that may make certain water sources or animals unsafe to drink or eat (Per. Com., R. Lowers, June 2010).



## B. Methods

In an effort to track the general health and movement patterns of alligators on KSC, alligators are routinely caught and tagged in freshwater ditches and impoundments throughout the MINWR. First the alligator is hooked with a treble hook attached to a long line or fishing pole. The alligator is pulled onto the bank and secured. Its mouth is then duct taped and its eyes covered with a black cloth. A PIT scanner is used to look for any PIT tags (internal tags) to see if the alligator has been caught before. If not then the alligator is tagged. Blood, urine, and a scute sample are taken for genetic purposes. Morphometric measurements such as length and girth are taken along with water quality measurements before the alligator is released.



Figure 11: Collecting urine sample



Figure 12: Inserting temperature probes in a nest

During nesting season, alligator nests are located and their GPS coordinates are recorded. Some nests can be spotted from the air using a helicopter; however most must be found by searching on the ground due to coverage from trees and large bushes. Nests are usually located close to a freshwater source such as a ditch or impoundment. Most of the time, the trail made by the adult female coming and going from her nest is evident and is marked by the "slide" she uses to enter and exit the water. A nest literally looks like a huge pile of dead vegetation. Once a nest is located, the presence of eggs is determined. Biologists place temperature probes in five nests with eggs every year spread out over a geographic area. The probes are placed at varying places in the nest: on top of the clutch, below the clutch, and at intermediate points between the two. The probes are attached to a stake which is firmly secured in the middle of the nest as a caution against losing any of the probes. After the hatchlings emerge and the nest is abandoned, the probes will be collected and the data will reveal the varying temperature at various points in the nest over the incubation period.



Figure 13: Preparing eggs for incubation

Egg clutches are collected from five different nests and incubated under controlled temperatures in the lab. When removing the eggs from the nests, a pencil mark is made at the top of the egg. This indicates which side should be facing up at all times, because if the eggs were to roll or be turned over, the embryo might detach from the side of the egg and die. In the lab, each egg is checked to see if it has been fertilized. Fertilized eggs will have a dark white band around the center of the egg. The eggs are then placed in a bin with a material resembling mulch that can hold up to five times its weight in water and placed in the incubator (Per. Com., R. Lowers, June 2010).

## VIII. Terrestrial Plants

Much of the undeveloped land on KSC is scrub composed mainly of small oaks and saw palmetto. The scrub provides habitat for many small mammals, reptiles and birds such as the Florida Scrub-Jay. Scrub is a fire managed ecosystem here on KSC/MINWR which up until recently was threatened by human interference (Per. Com., T. Foster, June 2010).

### A. Fire Management

Before the Merritt Island area was populated, the entire area would burn every few years or so mostly due to lightning strikes in the summer when everything was dry. The plant and animal species that live in the scrub evolved in this kind of environment. Natural fires also created openings in the scrub which were useful for small animals to forage and still be able to look out for aerial predators. When people started controlling forest fires without understanding the necessity of them for the environment, the scrub became overgrown creating a new environment that is not conducive for the plants and animals that live there. When scrub becomes overgrown, it loses a lot of the fuel necessary for a wide spread fire; therefore, it doesn't burn as easily and continues to become even more overgrown. Now the scrub is maintained with controlled burns (after mechanical treatment) to help reestablish the previous habitat, reduce hazardous fuel loads, reduce woody vegetation, and replenish nutrients to the soil (<http://www.fws.gov/merrittisland/Firemanagement.html>). Different



Figure 14: Controlled burn



sections of land are burned at varying intervals of time in an effort to create a mosaic of habitats which would more closely resemble the scrub's natural state (Per. Com., T. Foster, June 2010).

#### **B. Reflectance and Rate of Photosynthesis**

The stress on the scrub is monitored by taking monthly photosynthesis and reflectance measurements of four plant species: chapman oak (*Quercus chapmanii*), myrtle oak (*Quercus myrtifolia*), sand live oak (*Quercus geminata*), and saw palmeto (*Serenoa repens*). The rate of photosynthesis of a plant is controlled by the limiting factor be it carbon dioxide, water or sunlight. Reflectance indicates the amount of chlorophyll in a plant by measuring what color the plant is based on the wavelength of light reflected off the leaf. Well data is also taken to determine the amount of rainfall in the area and to compare to the photosynthesis and reflectance measurements (Per. Com., T. Foster, June 2010).

### **IX. Florida Scrub-Jay**

The Florida Scrub-Jay (*Aphelocoma coerulescens*) is a threatened species and is endemic to Florida. The Scrub-Jay population at KSC is one of the three largest remaining in the world. It is estimated that there are only 3,000 Scrub-Jays left. On KSC Scrub-Jays eat primarily acorns. During the fall they collect as many acorns as possible and stash them as a reserve food supply for the rest of the year. Scrub-Jays are very territorial and defend their territories with aggressive displays. They are not sexually dimorphic meaning that males and females look alike. Scrub-Jays are monogamous, which is rare among birds and animals in general, and nest between the months of March and June. Juveniles will stay with their parents for a few years helping them to defend the territory, mob predators, and feed young before claiming territories of their own. This is called cooperative breeding (Per. Com., D. Oddy, July 2010).



Figure 15: Florida Scrub-Jay (Photo courtesy of D. Oddy)

#### **A. Loss of Habitat**

Scrub-Jays' optimal habitat is oak scrub which unfortunately is also preferred by developers for housing developments and shopping centers. For this reason, the most critical threat to Scrub-Jays is loss of habitat. Their habitat can also be affected by suppressing natural forest fires. The scrub is naturally maintained by fire to prevent overgrowth and to create openings. This allows Scrub-Jays and other small wildlife to see overhead and watch for predators while they forage on the ground for food. As stated previously, the MINWR is now maintained with controlled burns (Per. Com., D. Oddy, July 2010).

#### **B. Methods**

In an effort to monitor the population size (survival, mortality and reproductive success) of Scrub-Jays at KSC, Scrub-Jays have been banded and surveyed monthly. The bands used are small plastic bands of various colors that fit around the bird's leg. Each Scrub-Jay has a USFWS silver band with a unique number and two to three color bands on its legs. The USFWS band is what identifies the bird in case one or more of the color bands fades or falls off. Peanut bits and acoustic recordings of territorial vocalizations are used to attract Scrub-Jays so that they can be identified. With this identification system, families and territories can be determined (Per. Com., D. Oddy, July 2010).

### **X. Southeastern Beach Mouse**

The Southeastern beach mouse (*Peromyscus polionotus niveiventris*) is a threatened species and is one of seven subspecies of the old field mouse. The beach mouse's optimal habitat is beach dunes and adjacent scrub. During the day it burrows in the sand dunes and forages at night for sea oats, seeds and some invertebrates. The beach mouse has a much lighter coloring than the old field mouse which helps it blend in with the sand to avoid predators. It has also been known to use ghost crab burrows as shelter from predators (<http://www.fws.gov/northflorida/Species-Accounts/Beach-Mice-2005.htm>).

#### **A. Loss of Habitat**

Formerly the distribution of the Southeastern beach mouse use to range from Ponce Inlet in Volusia County just north of the MINWR all the way down to Hollywood Beach in Broward County. With recent urbanization along the



coastline of most of Florida, habitat loss for the beach mouse has been significant. In fact the distribution of the Southeastern beach mouse is now almost entirely restricted to KSC and surrounding federal lands (Per. Com., D. Oddy, June 2010).

## **B. Methods**

In an effort to monitor the population size of the Southeastern beach mouse, traps were set up in a grid pattern. Then the traps are baited with sunflower seeds and cotton (used for nesting material) and set to trap the mice. The next morning the traps are checked, and in the case of a capture, the animal is ear tagged and the following is recorded: species, sex, weight, age and sexual activity are recorded before it is released at the point of capture.

A new noninvasive method for species determination is to record the footprints of the mouse as it enters and leaves a tracking tube. A database of footprints is being compiled to determine if the footprints of beach mice can be distinguished from other small mammals who overlap their geographical range (Per. Com., D. Oddy, June 2010).



Figure 16: Southeastern beach mouse (Photo courtesy of D. Oddy)

## **XI. Summary**

My internship with the Ecological Group at Kennedy Space Center involved the study of a variety of species native to the Merritt Island National Wildlife Refuge. Some of my regular activities included sea turtle nesting and hatchling surveys, alligator sampling, seagrass surveys, fish and shark tagging, Scrub-Jay surveys, beach mouse trapping, and taking reflectance measurements. The work being done with the Ecological Group is a major and important part of monitoring how Kennedy Space Center affects the environment around it. Since the Merritt Island National Wildlife Refuge is home to more endangered and threatened species than any other refuge in the U.S., it is of vital importance that we keep it in the most natural condition possible.

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